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<p>(21) International Application Number: PCT/US99/02268 (22) International Filing Date: 3 February 1999 (03.02.99) (30) Priority Data: 09/031,088 26 February 1998 (26.02.98) US (71) Applicant (for all designated States except US): INTERMEC IP CORP. [US/US]; 360 North Crescent Drive, Beverly Hills, CA 90210-4867 (US). (72) Inventor; and (75) Inventor/Applicant (for US only): PARATORE, Robert, M. [US/US]; 24209 Bostian Road, Woodinville, WA 98072 (US). (74) Agents: ABRAMONTE, Frank et al.; Seed and Berry LLP, 6300 Columbia Center, 701 Fifth Avenue, Seattle, WA 98104-7092 (US).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report. With amended claims.</p>
<p>(54) Title: MULTIFUNCTION ANTENNA MOUNTING FOR A COMMUNICATIONS INSTRUMENT, SUCH AS A SYMBOL READER</p>		
<p>(57) Abstract</p> <p>A wireless communications instrument, such as a symbol reader, includes a wireless communications device mounted in the body of the instrument and coupled to an antenna mounted in a cover, where the cover is movable with respect to the body between a closed position in which the cover is adjacent the body, and an open position in which the cover is spaced from the body such that the antenna is spaced from electronics located in the body. The instrument further includes a switch activated by the cover for placing the instrument in an ON state and an OFF state. The cover may be selectively positioned over a display screen, or keypad, to provide a protective covering over these elements.</p> <div data-bbox="828 1155 1380 1911"> </div>		

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MULTIFUNCTION ANTENNA MOUNTING FOR A COMMUNICATIONS INSTRUMENT, SUCH AS A SYMBOL READER

TECHNICAL FIELD

The present invention relates generally to the field of data collection and
5 communications instruments, and more specifically to antennas mounted to such
instruments.

BACKGROUND OF THE INVENTION

A large variety of instruments rely on antennas for providing wireless
communication between the instrument and some external system. For example, a radio
10 frequency (RF) communications link may be provided in a symbol reader for
downloading data collected by the symbol reader to an external system, such as a
computer network. The instrument will contain a wireless communications device such
as a transmitter, receiver, or transceiver and at least one antenna. The instrument may
also contain an output device such as a display screen and an input device such as an
15 input keypad. Examples of other instruments using similar components include cellular
telephones, laptop computers, desktop computers, and RF tag readers.

The antenna in such instruments is often mounted external to the housing
or body of the instrument. External mounting of the antenna provides two distinct
advantages. The first advantage is that the size of the housing or body will not limit the
20 length of the antenna. As is known in the art, the length of the antenna is a function of
both the operating frequency and the desired range, and is important to the proper
functioning of the antenna-transceiver combination. The second advantage is that the
antenna is spaced from the internal electronics, thereby limiting interference and cross-
talk between the antenna and the electronics.

25 While external antennas provide several distinct advantages, there are
also significant drawbacks to external antennas. An external antenna may unduly
increase the overall length of the communications instrument, making the instrument
difficult to carry and store. External antennas have been known to snag on surfaces,

which may dislodge the instrument from a user's hand or belt, or hinder the movement of emergency personnel carrying out their duties.

One approach to overcoming these drawbacks has been the use of retractable external antennas. Such retractable antennas are usually of a telescoping design, the antenna being retractable into the instrument's housing when not in use. Such retractable antennas must be fully extended when in use. External and retractable antennas tend to poke into objects and people and may easily break off. Another significant drawback of both external and retractable antennas is a concern expressed by public safety personnel, that such antennas make the personnel's presence obtrusive. For example, firefighters in high crime areas do not want to be mistakenly identified as police personnel.

SUMMARY OF THE INVENTION

The present invention overcomes the limitations of the prior art by providing an antenna in a cover or door that is mounted to the body of a communications instrument for movement with respect thereto between an open position and a closed position. In one exemplary embodiment, the antenna is mounted in a cover that is pivotally mounted to a symbol reader. In the closed position, the cover is positioned over a display screen to provide a protective covering for the display screen. In the open position, the cover is spaced from the display screen to provide an unobstructed view of the display screen and to space the antenna from electronics contained in the body of the symbol reader. A flat ribbon cable or a hinge coupling may serve to connect the antenna a transceiver in the body. A cover activated switch may turn the communications device "on" when the cover moves into the open position, and turn the communications device "off" when the cover moves into the closed position.

In another exemplary embodiment, a longer cover provides a protective covering to a keypad in addition to the display screen. Alternatively, the cover may be slidably mounted to the instrument for movement between the open and closed positions.

The cover may take the form of a substantially planar surface. The cover may have dimensions sufficient to contain a variety of antenna types and a multiplicity of antennas. Thus, the instrument may carry antennas for a variety of communications ranges and frequencies. The cover may be formed as a sandwich construction with the
5 antennas mounted therein. Alternatively, the antenna may be integrally molded within the cover.

Thus, the cover of the communications instrument discreetly hides the antenna. Opening the cover conveniently deploys the antenna in an operating position spaced from the internal electronics. Closing the cover conveniently stores the antenna
10 proximate the body of the instrument and provides protection to the screen, keyboard and instrument. The position of the cover also conveniently places the communications device in an ON or OFF state.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an isometric view of a first exemplary embodiment of the
15 invention in the form of a symbol reader having a door pivotally mounted thereto, with the cover being in the open position.

Figure 2 is an isometric view of the symbol reader of Figure 1 with the cover being in the closed position.

Figure 3 is a schematic view of the symbol reader of Figure 1 showing a
20 dipole antenna mounted in the cover and electronics in the symbol reader.

Figure 4 is a cross-sectional view of a cover showing a coil antenna therein.

Figure 5 is a cross-sectional view of a cover showing a pair of loop antennas mounted therein.

25 Figure 6 is a cross-sectional view of a cover showing three monopole antennas therein.

Figure 7 is an isometric view of a second exemplary embodiment in the form of a cellular phone, the cover in the open position.

Figure 8 is an isometric view of the exemplary embodiment of Figure 7, with the cover in the closed position.

Figure 9 is an isometric view of a third exemplary embodiment in the form of a radio frequency (RF) tag reader, having a cover slidably mounted thereto.

5 Figure 10 is a schematic view of the RF tag reader of Figure 9 showing a dipole antenna, a monopole antenna, and electronics in the RF tag reader.

DETAILED DESCRIPTION OF THE INVENTION

A communications instrument having at least one antenna mounted in a cover or door is described in detail herein. In the following description, numerous
10 specific details are set forth, such as particular electronics, antennas, mounting structures and input/output devices, in order to provide a thorough understanding of the invention. One skilled in the relevant art, however, will readily recognize that the present invention can be practiced without specific details, or with other such details. In other instances, well-known structures and operations are not shown in detail in order to
15 avoid obscuring the present invention.

Figure 1 shows a first exemplary embodiment of the invention, in the form of a symbol reader for reading machine readable symbols such as barcode symbols. The symbol reader 10 includes a housing 12 which carries a display screen 14 and a keypad 16. The display screen 14 displays information to a user, while the
20 keypad 16 permits the user to operate the reader 10. A hinge 20 pivotally mounts a cover 18 to the body 12 such that the cover 18 pivots between an open position shown in Figure 1, and a closed position shown in Figure 2. In the closed position, the cover 18 is positioned over the display screen 14 so as to protect the display screen 14 from accidental knocks and scratches. In the open position, the cover 18 is spaced from the
25 display screen 14 so as to permit the user to view the display screen 14.

Figure 3 is a cross-sectional view showing some of the electronics comprising the symbol reader 10. The symbol reader 10 includes an illumination source 22 for providing an illuminating beam to a machine readable symbol (not shown). The illuminating beam may be a fixed beam, or may be scanned across the

symbol by conventional scanning mechanisms which are well-known in the art. A detector 24 detects the illumination beam after it is reflected from the machine readable symbol, and converts the reflected beam into an electronic signal representative of the data encoded in the symbol. A microprocessor 26 controls the operation of the illumination source 22 and processes the electrical signals produced by the detector 24. The detector 24 may take the form of a charged couple device (CCD), or other such detecting device as is known in the art. The microprocessor 26 may execute programs stored in a read only memory (ROM) 28, or in a random access memory (RAM) 30. The microprocessor 26 may rely on lookup tables stored in the RAM 30 to decode the electrical signals produced by the detector 24. The microprocessor 26 may store the decoded data in the RAM 30 until it is convenient to download the data to an external system, such as a computer network (not shown). The symbol reader 10 contains a wireless communications device in the form of a transceiver 32 that includes a transmitter portion and a receiver portion. A hinge segment 33 of the hinge 20 electrically couples the transceiver 32 to a dipole antenna 34 contained in cover 18.

With reference to Figure 4, the antenna may take the form of a coil antenna 36. Alternatively, as shown in Figures 5 and 6, the cover 18 may contain multiple antennas, such as loop antennas 38, 39, or monopole antennas 40, 41, 43. Respective segments of the hinge 20 may provide the coupling link between the communication device 32 in the body 12 of the instrument 10 and each of the multiple antennas located in the cover 18. Alternatively, other coupling mechanisms, such as a flat ribbon cable, may provide the link. Such coupling mechanisms should be capable of withstanding repeated flexing due to the opening and closing of the cover 18.

With reference to Figures 7 and 8, a second exemplary embodiment is shown in the form of a cellular telephone 45. This alternative embodiment, and those described herein, are substantially similar to previously described embodiments, and common elements are identified by the same reference numbers. Only the significant differences are discussed in detail. The cellular phone 45 includes a microphone 42 and a speaker 44. In the second exemplary embodiment, the cover 47 has a longer dimension than the cover 18 from the first exemplary embodiment. The longer cover

47 provides at least two distinct advantages. First, the cover 47 is protectively extends over both the display 14 and the keyboard 16. Second, the longer length of the cover 47 permits the inclusion of a longer antenna.

A normally open switch 46 activates the apparatus 45 in response to the opening and closing of the cover 47. The switch 46 is on the body 12. The cover 47 physically engages the switch 46 when the cover 47 moves to the closed position (Figure 8), placing the switch 46 into an OPEN switch state. The cover 47 physically disengages the switch 46 when the cover 47 moves to the open position (Figure 7), placing the switch 46 into a CLOSED switch state. The switch 46 connects to the microprocessor 26 (Figure 3) or the transceiver 32 (Figure 3), for placing the microprocessor 26 or transceiver 32 in an ON state when the cover 47 is in the open position and for placing the device in an OFF state when the cover 47 is in the closed position. In this way the apparatus 45 turns ON when the cover 47 moves into the open position, the antenna being deployed in a position spaced from the internal electronics of the apparatus 45.

With reference to Figures 9 and 10, a third exemplary embodiment is shown in the form of an RF tag reader 50. Similar to the first embodiment, the tag reader 50 includes a body 12, a display 14 and keypad 16. In this embodiment, the cover 52 mounts in the body 12 for sliding movement between an open position and a closed position.

The RF tag reader 50 includes a transceiver 54 and antenna 56 for communicating with a RF tag (not shown). The transceiver 54 and antenna 56 produce an interrogation signal for interrogating the RF tag, and receive a data signal from the RF tag. The microprocessor 26 is coupled to ROM 28 and RAM 30. The transceiver 54 and antenna 48 may operate under control of the microprocessor 26 for reading an RF tag in a conventional manner as is known in the art. The RF tag reader 50 also includes a transceiver 58 and antenna 60 for communicating with an external system (not shown). Two transceiver and antenna pairs permit the tag reader 50 to communicate with an external communication system that functions at a different frequency than the frequency of the RF tag. This permits more efficient operational

parameters to be selected for the external communication system and limits the potential for interference from cross-talk. A pair of sliding contacts (not shown) formed between the body 12 and the cover 52 couple the antennas 34, 50 to the transceivers 32, 48, respectively.

5 Although specific embodiments of the antenna mounting and examples of the present invention have been described above for illustrative purposes, various equivalent modifications may be made without departing from the spirit and scope of the invention, as will be recognized by those skilled in the relevant art. The teachings provided herein of the present invention can be applied to other wireless
10 communications instruments, not necessarily the exemplary symbol reader, cellular phone, and RF tag reader generally described above. For example, a general purpose laptop or desktop computer having a microprocessor and memory could contain the wireless communications device (e.g. a wireless modem). Other mechanisms for coupling the wireless communications device located in the body with the antenna
15 located in the cover may be employed.

 These and other changes can be made to the invention in light of the above detailed description. In general, in the following claims, the terms should not be construed to limit the invention to the specific embodiments disclosed in the specification and claims, but should be construed to include all apparatus for mounting
20 an antenna in a cover. Accordingly, the invention is not limited by the disclosure but instead its scope is to be determined entirely by the following claims.

CLAIMS

1. An instrument that provides wireless communications comprising:

a body;

a protective member having an approximately planar portion, the protective member mounted to the body for movement with respect thereto between an open position and a closed position;

an antenna received in the protective member for movement therewith; and

a wireless communications device received in the body and connected to the antenna.

2. The instrument of claim 1 wherein the wireless communications device comprises an RF transceiver.

3. The instrument of claim 1 further comprising:

a light detector mounted in the body to receive light reflected by a machine readable symbol, the light detector coupled to a microprocessor for providing electrical signals to the microprocessor that correspond to the received light.

4. The instrument of claim 1 wherein the wireless communications device comprises a transmitter.

5. The instrument of claim 1 wherein the wireless communications device comprises a receiver.

6. The instrument of claim 1 wherein the protective member is mounted to the body for sliding movement.

7. The instrument of claim 1 wherein the protective member is mounted to the body for pivotal movement.

8. The instrument of claim 1, further comprising:
a display screen carried by the body and positioned thereon such that the display screen is covered by the protective member when the protective member is in the closed position and exposed when the protective member is in the open position.

9. The instrument of claim 1, further comprising:
a keypad carried by the body and positioned such that the key pad is covered by the protective member when the protective member is in the closed position and exposed when the protective member is in the open position.

10. The instrument of claim 1, further comprising:
a display screen carried by the body; and
a keypad carried by the body, wherein
the protective member covers the display screen and the key pad when the protective member is in the closed position and the protective member uncovers the display screen and the key pad when the protective member is in the open position.

11. The instrument of claim 1, further comprising:
a switch mounted in the body and coupled to the protective member such that the switch turns the wireless communications device on when the protective member is in the open position and the switch turns the wireless communications device off when the protective member is in the closed position.

12. The instrument of claim 1 wherein the antenna is a monopole antenna.

13. The instrument of claim 1 wherein the antenna is a dipole antenna.

14. The instrument of claim 1 wherein the antenna is a coil antenna.

15. The instrument of claim 1, further comprising:

a microprocessor received in the body; and

a switch mounted in the body and coupled to the protective member such that the switch turns the microprocessor on when the protective member is in the open position and the switch turns the microprocessor off when the protective member is in the closed position.

16. The instrument of claim 1, further comprising:

a microprocessor received in the body;

an output device carried by the body, the output device driven by the microprocessor;

an input device carried by the body, the input device connected to the microprocessor; and

a switch mounted in the body and coupled to the protective member such that the switch turns the microprocessor on when the protective member is in the open position and the switch turns the microprocessor off when the protective member is in the closed position.

17. The instrument of claim 1 wherein the antenna mounted in the cover is proximate the body in an undeployed position when the cover is in the closed position and spaced relatively from the body in a deployed position to enhance communications when the cover is in an open position.

18. A symbol reader for retrieving, storing and transmitting data encoded in a machine readable symbol, the symbol reader comprising:

a body;

a microprocessor mounted in the body;

a light detector mounted in the body to receive light reflected by the machine readable symbol, the light detector coupled to the microprocessor for providing electrical signals to the microprocessor that correspond to the received light;

a wireless communications device received in the body and coupled to the microprocessor for operation thereby;

a cover mounted to the body for movement with respect thereto between an open position and a closed position; and

an antenna received in the cover for movement therewith, the antenna being coupled to the wireless communications device.

19. The symbol reader of claim 18, further comprising:

a display screen carried by the body and positioned thereon such that the display screen is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

20. The symbol reader of claim 18, further comprising:

a keypad carried by the body and positioned thereon such that the key pad is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

21. The symbol reader of claim 18, further comprising:

a switch responsive to the position of the cover and coupled to the wireless communications device such that the switch turns the wireless communications device on when the cover is in the open position and the switch turns the wireless communications device off when the cover is in the closed position.

22. The symbol reader of claim 18, further comprising:

an illuminating light source mounted in the body for illuminating the machine readable symbol for reading.

23. An RF tag reader for reading an RF tag, the RF tag reader comprising:

- a body;
- a microprocessor mounted in the body;
- an RF transmitter mounted in the body and coupled to the microprocessor;
- an RF receiver mounted in the body and coupled to the microprocessor;
- a cover mounted to the body for movement with respect thereto between an open position and a closed position; and
- an antenna received in the cover for movement therewith, the antenna coupled to the RF transmitter and the RF receiver.

24. The symbol reader of claim 23, further comprising:

- a display screen carried by the body and positioned thereon such that the display screen is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

25. The symbol reader of claim 23, further comprising:

- a keypad carried by the body and positioned thereon such that the key pad is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

26. The symbol reader of claim 23, further comprising:

- a switch responsive to the position of the cover and coupled to the wireless communications device such that the switch turns the wireless communications device on when the cover is in the open position and the switch turns the wireless communications device off when the cover is in the closed position.

27. A general purpose computer comprising:

- a body;
- a microprocessor mounted in the body;

a memory coupled to the microprocessor;
a wireless communications device received in the body and coupled to the microprocessor;
a cover mounted to the body for movement between an open position and a closed position; and
an antenna mounted in the cover for movement therewith between a deployed position when the cover is in an open position and an undeployed position when the cover is in the closed position, the antenna coupled to the wireless communications device for providing a signal path therebetween.

28. The general purpose computer of claim 27, further comprising:
a display screen carried by the body and positioned thereon such that the display screen is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

29. The general purpose computer of claim 27, further comprising:
a keypad carried by the body and positioned thereon such that the key pad is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

30. The general purpose computer of claim 27, further comprising:
a switch responsive to the position of the cover and coupled to the wireless communications device such that the switch turns the wireless communications device on when the cover is in the open position and the switch turns the wireless communications device off when the cover is in the closed position.

AMENDED CLAIMS

[received by the International Bureau on 19 July 1999 (19.07.99);
original claims 1-7, 9, 11-18 and 23 amended;
original claims 8, 10, 19 and 26-30 cancelled;
remaining claims unchanged (5 pages)]

1. A data carrier reader that provides wireless communications comprising:

a body;

an protective member having an approximately planar portion, the protective member mounted to the body for movement with respect thereto between an open position and a closed position;

an antenna received in the protective member for movement therewith;

a wireless communications device received in the body and connected to the antenna; and

a display screen carried by the body and positioned thereon such that the display screen is covered by the protective member when the protective member is in the closed position and exposed when the protective member is in the open position.

2. The data carrier reader of claim 1 wherein the wireless communications device comprises an RF transceiver.

3. The data carrier reader of claim 1 further comprising:

a light detector mounted in the body to receive light reflected by a machine readable symbol, the light detector coupled to a microprocessor for providing electrical signals to the microprocessor that correspond to the received light.

4. The data carrier reader of claim 1 wherein the wireless communications device comprises a transmitter.

5. The data carrier reader of claim 1 wherein the wireless communications device comprises a receiver.

6. The data carrier reader of claim 1 wherein the protective member is mounted to the body for sliding movement.

7. The data carrier reader of claim 1 wherein the protective member is mounted to the body for pivotal movement.

9. The data carrier reader of claim 1, further comprising:
a keypad carried by the body and positioned such that the key pad is covered by the protective member when the protective member is in the closed position and exposed when the protective member is in the open position.

11. The data carrier reader of claim 1, further comprising:
a switch mounted in the body and coupled to the protective member such that the switch turns the wireless communications device on when the protective member is in the open position and the switch turns the wireless communications device off when the protective member is in the closed position.

12. The data carrier reader of claim 1 wherein the antenna is a monopole antenna.

13. The data carrier reader of claim 1 wherein the antenna is a dipole antenna.

14. The data carrier reader of claim 1 wherein the antenna is a coil antenna.

15. The data carrier reader of claim 1, further comprising:
a microprocessor received in the body; and
a switch mounted in the body and coupled to the protective member such that the switch turns the microprocessor on when the protective member is in the open position and the switch turns the microprocessor off when the protective member is in the closed position.

16. The data carrier reader of claim 1, further comprising:
a microprocessor received in the body;
an output device carried by the body, the output device driven by the microprocessor;
an input device carried by the body, the input device connected to the microprocessor; and
a switch mounted in the body and coupled to the protective member such that the switch turns the microprocessor on when the protective member is in the open position and the switch turns the microprocessor off when the protective member is in the closed position.

17. The data carrier reader of claim 1 wherein the antenna mounted in the cover is proximate the body in an undeployed position when the cover is in the closed position and spaced relatively from the body in a deployed position to enhance communications when the cover is in an open position.

18. A symbol reader for retrieving, storing and transmitting data encoded in a machine readable symbol, the symbol reader comprising:
a body;
a microprocessor mounted in the body;

a light detector mounted in the body to receive light reflected by the machine readable symbol, the light detector coupled to the microprocessor for providing electrical signals to the microprocessor that correspond to the received light;

a wireless communications device received in the body and coupled to the microprocessor for operation thereby;

a cover mounted to the body for movement with respect thereto between an open position and a closed position; and

an antenna received in the cover for movement therewith, the antenna being coupled to the wireless communications device; and

a display screen carried by the body and positioned thereon such that the display screen is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

20. The symbol reader of claim 18, further comprising:

a keypad carried by the body and positioned thereon such that the keypad is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

21. The symbol reader of claim 18, further comprising:

a switch responsive to the position of the cover and coupled to the wireless communications device such that the switch turns the wireless communications device on when the cover is in the open position and the switch turns the wireless communications device off when the cover is in the closed position.

22. The symbol reader of claim 18, further comprising:

an illuminating light source mounted in the body for illuminating the machine readable symbol for reading.

23. An RF tag reader for reading an RF tag, the RF tag reader comprising:

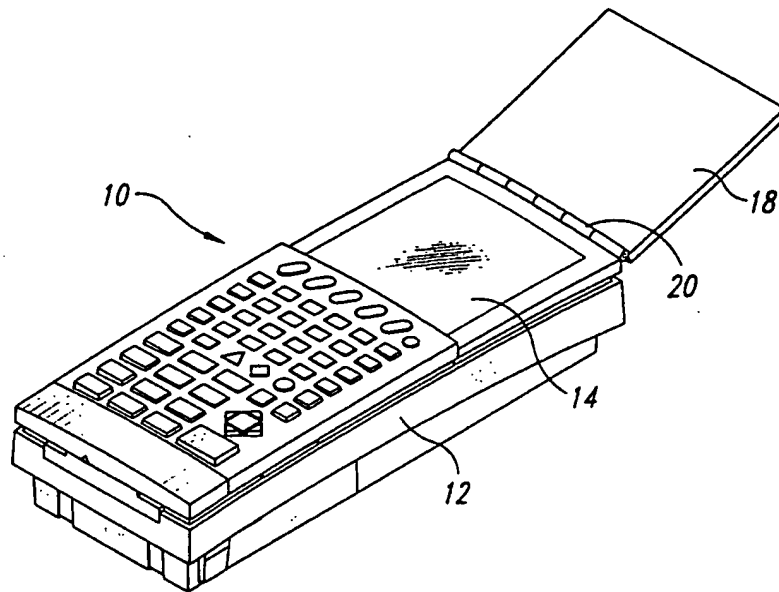
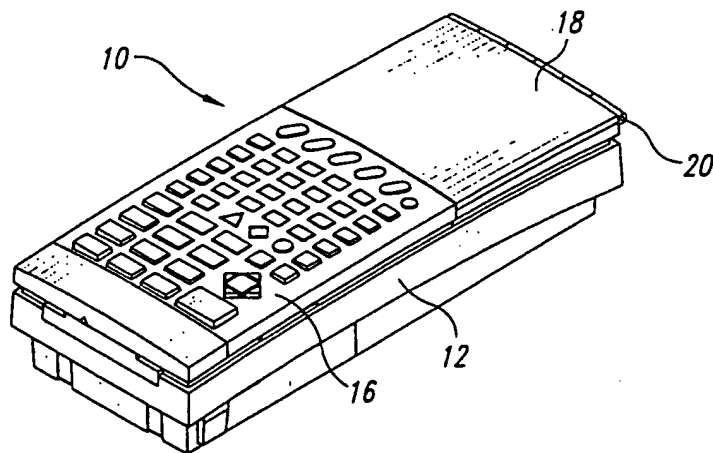
- a body;
- a microprocessor mounted in the body;
- an RF transmitter mounted in the body and coupled to the microprocessor;
- an RF receiver mounted in the body and coupled to the microprocessor;
- a cover mounted to the body for movement with respect thereto between an open position and a closed position;
- an antenna received in the cover for movement therewith, the antenna coupled to the RF transmitter and the RF receiver; and
- a switch responsive to the position of the cover and coupled to the wireless communications device such that the switch turns the wireless communications device on when the cover is in the open position and the switch turns the wireless communications device off when the cover is in the closed position.

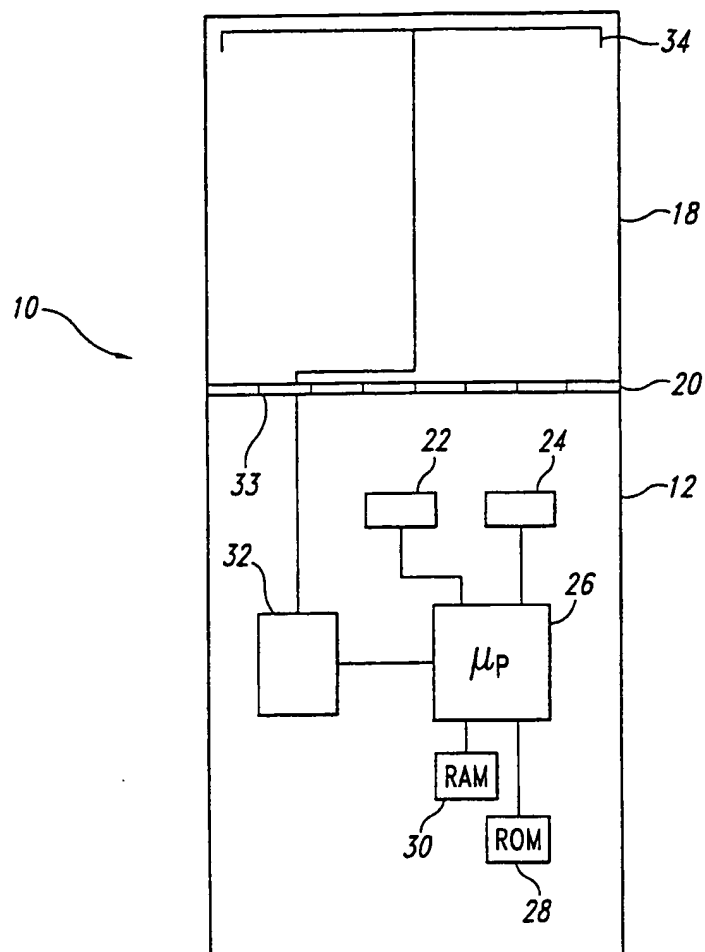
24. The symbol reader of claim 23, further comprising:

- a display screen carried by the body and positioned thereon such that the display screen is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

25. The symbol reader of claim 23, further comprising:

- a keypad carried by the body and positioned thereon such that the keypad is covered by the cover when the cover is in the closed position and exposed when the cover is in the open position.

*Fig. 1**Fig. 2*

*Fig. 3*

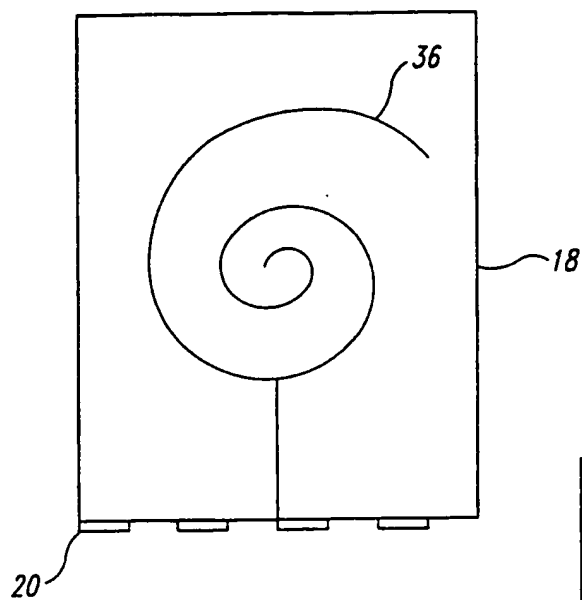


Fig. 4

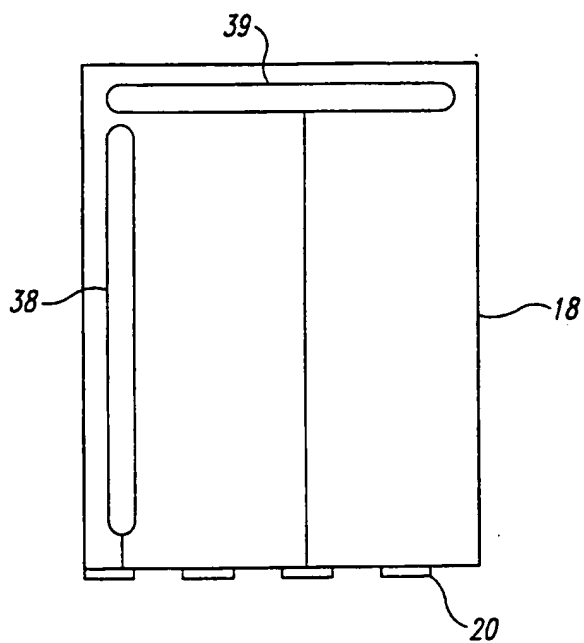


Fig. 5

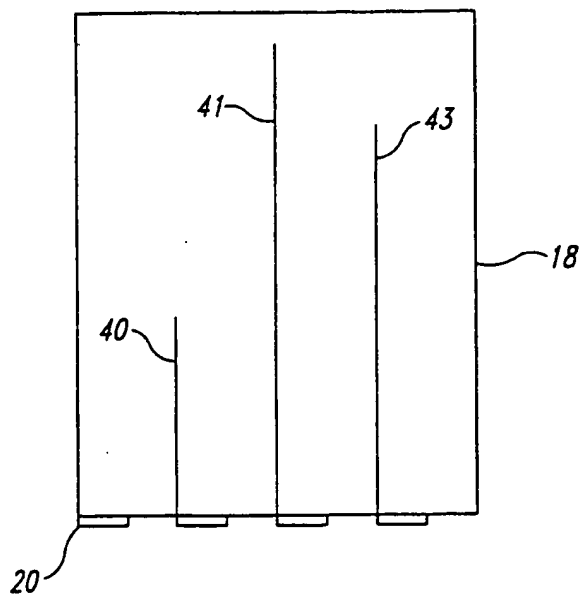
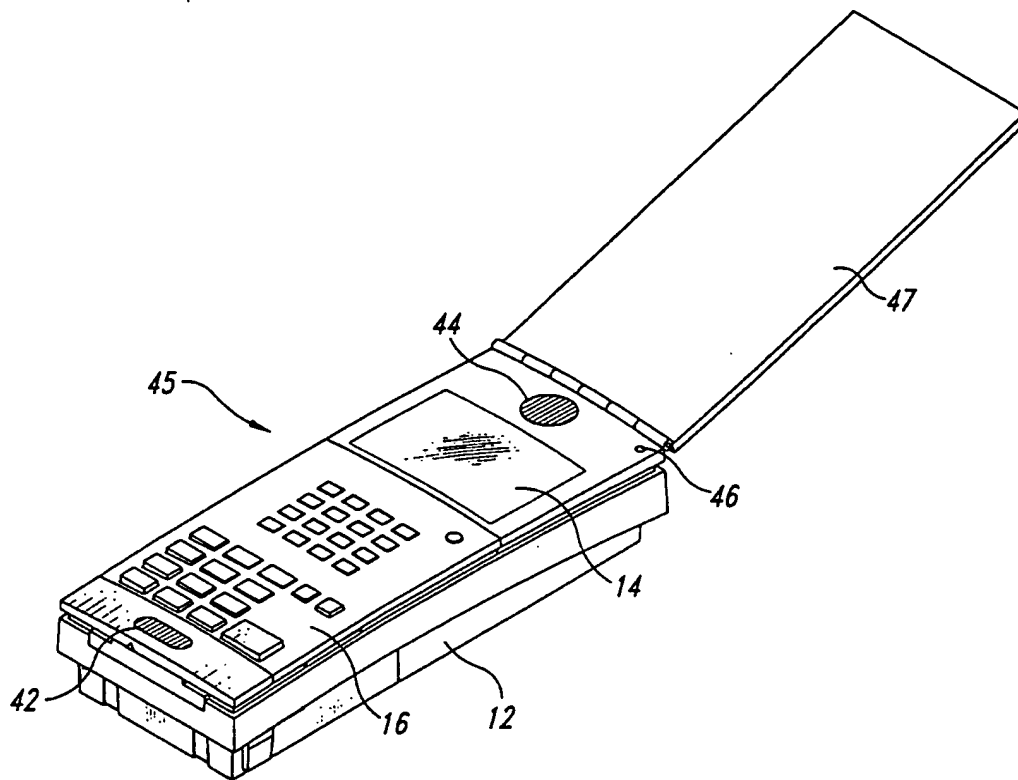
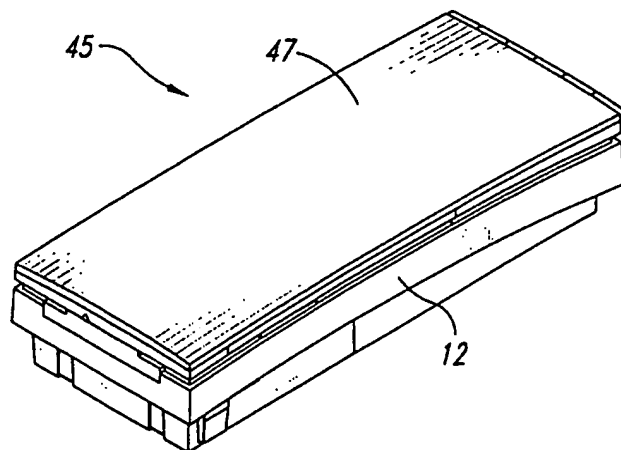
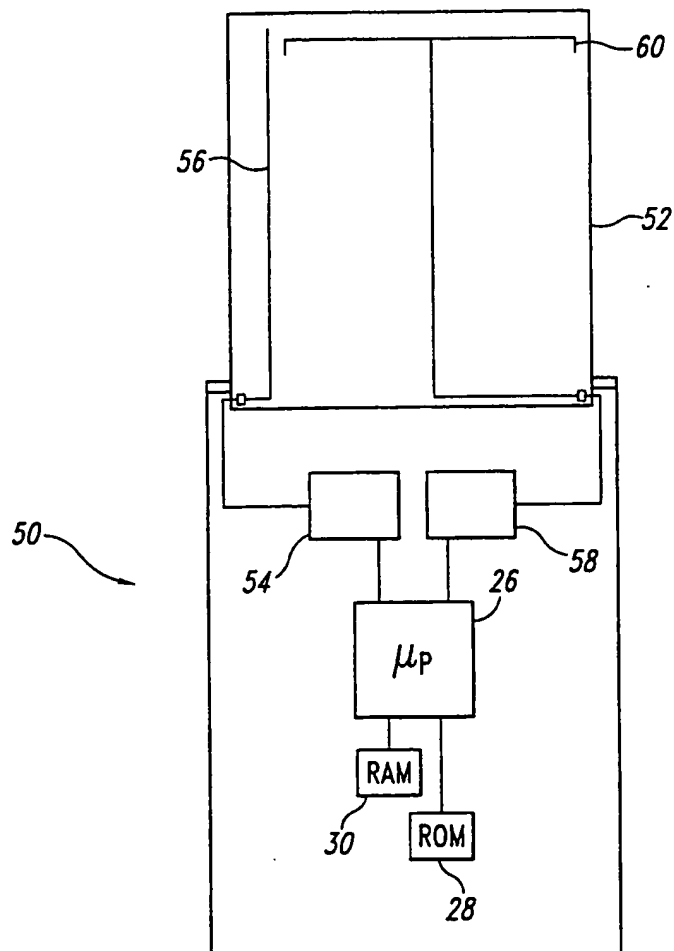
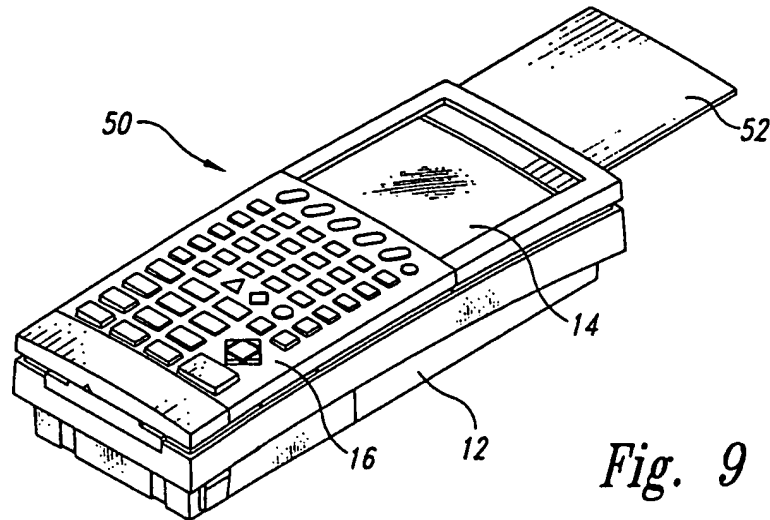


Fig. 6

*Fig. 7**Fig. 8*

5/5



INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 99/02268

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01Q1/24 H01Q1/22 H01Q1/08 G06K7/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01Q G06K H04B H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 508 567 A (SHAYE COMMUNICATIONS) 14 October 1992	1,2,4,5, 7,9, 12-14, 23,25, 27-30
Y	see abstract see column 2, line 32 - column 4, line 21; figures 1-3 --- -/--	3,6,8, 10,11, 15-22, 24,26

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

17 May 1999

Date of mailing of the international search report

21/05/1999

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/02268

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 5 324 925 A (KOEMCK ET AL.) 28 June 1994 see column 2, line 59 - column 3, line 7; figures 2-6 ---	1-30
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A	EP 0 607 038 A (NEC) 20 July 1994 see column 2, line 17 - column 3, line 57; figures 1-2B -----	1-30

INTERNATIONAL SEARCH REPORT

information on patent family members

Inter. nat. Application No

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